

Second Phase Guidelines for Instream Work

Irene Flood Disaster Recovery
Vermont Agency of Natural Resources
October 5, 2011

Flood disaster recovery is transitioning from verbal to primarily written instream work authorizations. Resolving or managing conflicts between human investments and the dynamics of rivers, for longer term stability, requires that the State move past the emergency phase and into permanent rebuilding in preparation for the next flood.

The Agency will continue to do everything in its power to expedite emergency and in-stream recovery work. With the need for permanent fixes, however, the deliberation of alternatives and documentation of stream work have become more critical. The DEC River Management Engineers will continue to provide technical assistance to landowners, municipalities, and other agencies in support of recovery operations, helping to reduce vulnerability, loss, and public safety hazards during the next flood. Moving forward, the DEC River Management Engineers will use the following three categories of authorization for stream alteration work:

1. **Expedited assistance and approvals for Emergency Situations.** DEC Rivers Program staff will use its Stream Alteration statute emergency authority and will use its stream alteration general permit to address emergency situations that still exist as a result of the flood (i.e., necessary to avoid imminent danger to private and public property). The stream alteration general permit allows for certain categories of non-reporting activities to proceed in accordance with the terms of the permit. The Program will provide expedited written and verbal approvals to facilitate work under its emergency authority and the general permit's non-reporting category and to serve the purpose of documenting compliance with state laws necessary to secure state and federal grants and reimbursement for flood recovery work.
2. **Non-emergency flood-related work.** DEC Rivers Program will use its stream alteration general permit non-reporting category to expedite approvals of stream alteration work related to the flood but not deemed to be an emergency. The Rivers Program will not authorize this category of work using purely verbal approvals. These written approvals will also serve the purpose of documenting the compliance with state laws necessary to secure state and federal grants and reimbursement for flood recovery work.
3. **Stream Alteration Work Not Related to Flood Disaster Recovery.** The DEC Rivers Program will use its stream alteration general permit and individual permit authority to authorize activities unrelated to the current flood disaster recovery effort. This includes those activities that may already proceed as non-reporting activities under the State Stream Alteration General Permit (<http://www.anr.state.vt.us/dec/waterq/rivers.htm>). The following practices can contribute to damage caused by flood erosion and inundation. In the case of berms, local approvals may be required. Individual stream alteration permits will be required from the DEC Rivers Program prior to the use of other listed stream channelization techniques:
 - a. **Berming** – using gravel and other aggregate, from any source, to fill and create a linear barrier between the river and its floodplain. By preventing the river from flooding in the floodplain, more water is contained within the channel, and with deeper water comes higher velocities and more erosion. Berms tend to provide a false sense of security to people living on the other side, and, as Irene has shown, when berms are most needed to function—they fail. During floods some berms will hold up, but where there is any weakness, the river breaks through, and the berm fails catastrophically causing localized increases in flood water elevations.

Placement of fill in a mapped floodway or special flood hazard area must meet the requirements of the National Flood Insurance Program in those communities enrolled in the NFIP. Fill is not permitted in the floodway unless the applicant can demonstrate, using standard engineering practices, that the proposed development with fill will not result in an increase in base flood elevations (44 CFR §60.3). Municipal approval under the community's flood hazard bylaw and state review by the Floodplain Management Program are required for floodway and floodplain fills.

- b. **Excavating and rechanneling streams in unstable dimensions and/or elevations** – excavating the channel substantially deeper, wider, and/or steeper than the dimensions and longitudinal slope of the channel required for the annual flood discharge (~ Q1.5 discharge); or extending dredging operations beyond that necessary for the removal of existing threats is curtailed. Over-widening or over-deepening a channel, far in excess of its typical bankfull dimensions (channel width and depth containing the annual flood discharge), often leads to sediment deposition, headcutting, and bed erosion patterns that may increase hazards to nearby structures and infrastructure (see figure below).

These activities may be authorized, however, in severely aggraded areas, where ongoing aggradation (i.e., sediment accumulation and management) is anticipated by the Rivers Program, and where use of materials in flood recovery may reduce other emergencies situations. However, commercial gravel mining in streams is prohibited by law, and statutory limits for riparian landowner use of 50 cubic yards without a permit still apply in flood recovery periods.

- c. **Creating new straightened river channels** – excavating new channels that did not exist prior to the flood event will not be allowed, except in very limited circumstances, where threats to life and critical infrastructure would exist otherwise. During prior post-flood eras, rivers and streams were moved and straightened to the valley sides to recover and reclaim lands for other purposes. This practice led to steeper, more powerful flows which eroded (incised) stream beds and increased erosion hazards, as the streams then began to widen, re-meander, and form new floodplains where investments had been made. This historic practice is one of the primary human contributions to the flood damages experienced today.
- d. **Reconstruction of streambanks and/or roadway embankments** - encroaching into and excessively narrowing the stream channel and/or using undersized or otherwise unsuitable materials for streambank and/or roadway embankment stabilization will likely increase flood and erosion hazards.



Road shoulder is widened such that the toe of the slope significantly constricts the river.
Stone fill, placed to protect the slope, is at risk because it is undersized.

Please be patient as field engineers will continue to need to set priorities during this extraordinary event.

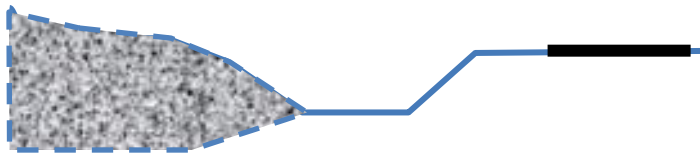
Contact information and coverage maps for River Management Engineers is located at:

[http://www.anr.state.vt.us/dec/waterq/rivers/docs/ANR%20River%20Engineers%20for%20Irene%20Recovery_1%20\(2\).pdf](http://www.anr.state.vt.us/dec/waterq/rivers/docs/ANR%20River%20Engineers%20for%20Irene%20Recovery_1%20(2).pdf)

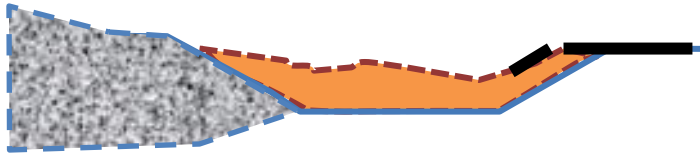
Recommendations for Instream Work Alternatives: Risk assessments are made and statutory requirements (i.e., public safety, hazard mitigation, and habitat protection, 10 V.S.A., § 1023) are factored when considering the following types of instream flood recovery work:

1. **Excavating sediment to open up stream channels:** Stream segments are determined acceptable for channel excavation based on priorities for protecting critical infrastructure and public safety. Where the river is choked with sediment, to the point where the water will be diverted, for instance, around bridges and into homes, sediment and debris will be excavated to at least a pre-flood level of safety, extracting the largest sediment deposits, or excavated to a designed width and depth, based approximately on Q1.5 (annual flood) flows. Where public safety risks are not high, and Q1.5 channel capacity largely exists, excavation will not be authorized as an expedited recovery practice. Straightened and incised streams, hit with high sediment yielding floods, create new meanders and floodplains, which are very beneficial in dissipating the energy of future floods. Where floodplains have been reformed, recommendations will be made to leave the river and new floodplain as wide open as existing infrastructure will allow.
2. **Removing debris:** Large woody debris (LWD) is beneficial in natural stream systems as it contributes greatly to the roughness of the stream channel, reducing the overall velocities and the stream power acting on the bed and banks of the stream. Importantly, LWD provides critical ecological benefits. Three risk levels are evaluated:
 - a. High Risk: During a large event, such as Tropical Storm Irene, massive quantities of trees were eroded from hill slopes and may have clogged the stream channel. Similar to sediment deposits, a risk assessment is needed. When trees have entered and formed a debris jam that spans a channel that is confined between the valley walls and/or roadway embankment, and there is no relief, or flow path around the debris jam, water may build up to significant depth upstream of the jam such that the debris mass may be remobilized. Debris jams in this situation should be removed if its sudden release during the next flood would cause a surge of water and/or sediment that would risk critical infrastructure and public safety. Channel spanning jams where the stream channel is not confined between the valley walls may cause severe channel infilling and stream avulsion, where the flood waters may jump from the existing channel and form a new stream path elsewhere in the valley where other developed properties may be at risk. Debris in this situation should be removed.
 - b. Moderate Risk: Large side bar or mid-channel accumulations of woody debris where channels are unconfined between the valley walls and potential channel avulsion does not threaten improved property, may pose a moderate level of risk and should be evaluated for their potential to become mobilized and jam against a nearby bridge or culvert downstream. If this is likely, the debris accumulation should be recommended for removal.
 - c. Low Risk: Other side bar accumulations of wood or single embedded pieces of wood are considered low risk and should be left in place as beneficial habitat and channel roughness.
3. **Streambed and bank armoring:** While many stream reaches have filled in with sediments, others have been scoured of bed sediments. Where deepened channels have been carved adjacent to a road, and the road shoulder must be reestablished, the restoration may include a practice of raising the adjacent stream bed with weirs or a blanket of coarse rocks. Such a treatment would reduce the height of the streambank or roadway embankment relative to the streambed elevation and minimize the lateral extent of reconstructed road embankment, and its encroachment into the stream channel. If road restoration or any streambank armoring pinches a stream, flood flows become narrowly confined causing further erosion of the bed, and undermining the embankments protective rock rip-rap, leading to another failure of the streambank and/or road. The risks associated with this practice must be evaluated and construction details provided by the DEC River Management Engineer.
4. **Maintain old and new flood chutes:** Many old flood chutes and new flood chutes are secondary “relief valve” stream channels on the inside of meander bends and should be maintained in preparation for the next flood. This may require removal of debris and sediments in the flood chute opening and may also warrant regrading of the flood chute to prevent injury to people or animals due to unstable and/or steep flood chute walls. Flood chutes may be regraded into shallow swales along the full length of the chute so that future flood waters may have easy access to the chute. These activities require technical assistance and approval of the DEC River Engineers.
5. **Replacing culverts:** Culvert Replacement Guidance prepared by the Vermont Fish and Wildlife Department is attached to and a part of this ANR Second Phase Guidance for Instream Work.

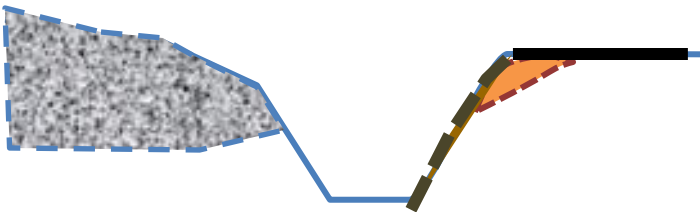
Avoid Excavating the Stream Channel Too Deep



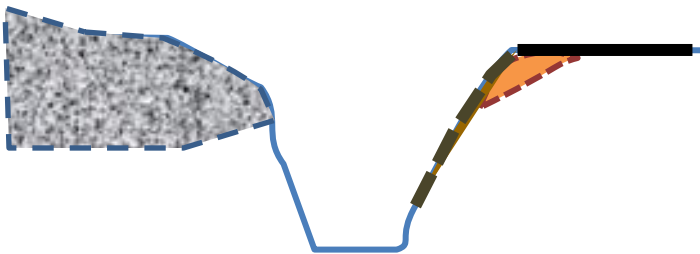
Pre-flood stream channel / floodplain cross-section; with road surface to the right and a more erosion resistant valley side wall depicted on the left.



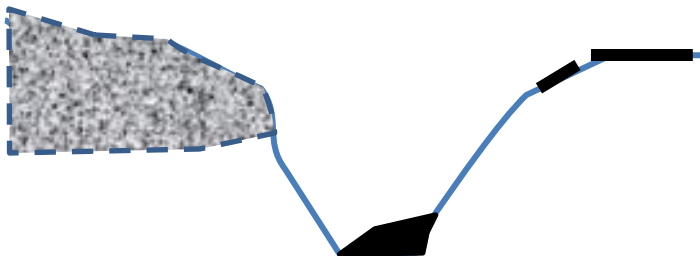
Channel and road shoulder eroded during peak flood flow, then, during flood recession, the new wider channel completely fills with sediment.



Channel is excavated (too deep) and flood generated sediment is used to shore up road shoulder, road is remade and stream bank is armored.



Another flood event occurs, and flood flows are contained between the resistant left bank and the armored right bank; the increased power erodes the stream bed further, below the armoring, and flows are further impinged against road embankment.



Almost immediately, and often during the same flood event, the impinging flows of the incised stream channel will also erode the embankment and cause the rip-rap bank armor to fall to the bottom of the channel.

When excavating an aggraded stream bed -- establish channel width and depth to convey the annual flood (~ Q1.5 discharge) and avoid bed incision and stream bank and road failure.

Vermont Rivers Program - <http://www.vtwaterquality.org/rivers.htm>